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Good afternoon Chairman Quayle, Ranking Member Wu, and Members of the Committee. It is an honor to appear before you today to testify about the role that the Small Business Innovation Research (SBIR) program has played in Galois' business, and its effectiveness in promoting innovation.

My name is Laura McKinney, and I serve as CEO of Galois, Inc., and as a member of Galois' Board of Directors.

Let me begin by thanking the Members of this Committee for your work in promoting policies that assist the growth of small businesses in this country. Small businesses are known to be a significant engine of innovation, and your role in promoting policies that have fostered innovation and created jobs in the U.S. is to be commended. The SBIR program is one such example.

For this testimony, the subcommittee requested the following information:

1) Description of Galois' awards and experience with the SBIR program.
2) Discussion of how Galois' SBIR-funded work has impacted our community and/or the nation.
3) Recommendations for improvements to the program.

We have addressed all three of the questions in the following testimony. I am able to speak from the perspective of Galois' specific experiences with the SBIR and STTR programs. It is my

desire to share our story with as much depth and fidelity as possible, recognizing that it will naturally have its parochial limits. When we give recommendations, we do so based solely on what we know directly, and in recognition that our experiences may either be unique or may generalize. We acknowledge the excellent work of the National Research Council and others who bring a broader viewpoint to sort out what might best apply in the larger context and community.

Overview

Galois is a 10-year-old small business located in Portland, Oregon. Galois' mission is creating trustworthiness in critical systems. Our approach is to transform computer science research into practice to address urgent problems with safety and security software. Think of Galois as a vital part of the supply chain that takes relatively new research technology up the hill through feasibility proof and operational demonstration stages.

Galois employs over 30 people, most as employees and some under contract. We are a mix of researchers with world-recognized expertise paired with highly-skilled engineers whose practical experience converts research ideas into viable implementations. Among the 24 permanent technical staff, almost 60% hold a PhD, another 25% hold an MS, and five are former university professors. All are specialists in computer science, with emphasis on formal methods and high assurance techniques in software. Galois draws its expertise from a global community, with degrees represented from many first rank US universities as well as overseas schools such as Oxford, Cambridge, and UNSW in Sydney.

The primary problem domains we address include those motivated by needs in cybersecurity, such as high assurance architectures, cross-domain information exchange, cryptography, and secure embedded devices. Galois' customers include the intelligence community, Navy, NASA, Army, Air Force, DARPA, DOE, Raytheon, and General Dynamics, plus other companies in the industrial and commercial sectors. Some of Galois' partnerships and relationships include Rogue River Research (Ashland Oregon), Portland State University, Oregon State University, defense contractors such as DRS, commercial entities in the cybersecurity domain such as OK Labs, and small businesses such as Dornerworks.

Galois' revenues are generated through collaborative research projects, transition support, and

licensing of technologies to product companies. Approximately 17% of current Galois revenues are through SBIR Phase-I and Phase-II contracts and grants, making the SBIR program a modest but highly leveraged part of our business.

In particular, the SBIR program is a critical enabler that allows Galois to bring maturing research results developed under long-term initiatives to bear on immediate needs. We combine emerging software techniques and tools with inventions to meet specific operational requirements. Often we partner with both academia and solution providers to make this possible. Thus a primary contribution for Galois is magnifying the investment in research results funded under one government agency to a broader government and commercial community.

The technology transition gap between universities and industry

Galois, Inc., had its roots in an Air Force research project undertaken in the 90's by the Oregon Graduate Institute. This project, and the visionary leadership of the Air Force management in guiding its progress, provided a model for many of the elements necessary to achieve technology transition. However, despite all the emphasis on transition, superior technology, and a viable implementation, the results failed to reach deployment and bring operational value. Ultimately Galois was founded in response to the technology transition lessons learned under this effort.

This background is worth examining in some detail, as it demonstrates the critical role that companies like Galois can play, as they inhabit the R&D space between Universities and large industrial and commercial concerns.

As background, the Oregon Graduate Institute was a research-focused, graduate school that flourished due to the excellence of the researchers and their ability to provide compelling research results. The Oregon Legislature chartered OGI in 1963 to provide graduate-level training and expertise to the state's rapidly expanding high-tech industry. *"During the 1990s the school awarded over one thousand graduate degrees, offered hundreds of continuing education seminars and workshops, and secured more than $100 million in largely federally-funded research. In 2001, OGI merged with Oregon Health Sciences University."* (Quoted from the OGI web site).

One of the projects in the 90s was a multi-year, multi-million dollar grant to improve the

production and reliability of message passing systems within the US Air Force. The Air Force sponsors were committed to seeing that the research resulted in tangible and direct benefits. To enable the academic group to better meet the expectations of an operationally-focused customer, they assigned an advisor in addition to the program management oversight.

The project ultimately delivered a mature prototype message-passing system. In a controlled software engineering experiment against an existing operational solution, the system was proven to significantly improve both the productivity of the engineers that code the messages and reduce the number of errors encountered. Potential value to the Air Force included increased capability to produce new message formats, with lower failures, in response to changing mission needs.

The researchers and the Air Force advisor worked together to add rigorous project management, to complement researchers with highly-skilled engineers, to educate the team about the Air Force mission and current solutions, and to structure the project with a tangible demonstration of value as its goal. This research community learned new approaches in terms of scope, rigor and perspective.

However, there was one critical link that was missing that prevented the ultimate deployment of this system, and that was a commercially-motivated entity to take this mature prototype and bring it into use. Despite significant interest and commitment to do so, the effort was simply outside of the mission of OGI as an educational research institute. It was a source of significant frustration to many team members that this valuable technology was essentially abandoned.

Galois' inception

In 1999, Dr. John Launchbury, an OGI professor, was approached by a research group within the intelligence community to address a critical problem in the specification of cryptographic algorithms. Some of the elements of this work drew on the research results from the prior Air Force project and elsewhere.

Significantly, both the OGI professor and the government realized that in order for this initiative to be successful, the research and development needed to be done within an entity that could nurture the system through to actual use. John Launchbury took the lessons learned from OGI and founded Galois, which has since grown steadily and strongly, winning multiple Oregon

business awards and honors, including John Launchbury's selection as finalist for Entrepreneur of the Year in 2002 by the Portland Business Journal.

Cryptographic specification became the first project for Galois as well the inspiration for Galois' name, which is in honor of Evariste Galois, a 17th century French mathematician who invented the theory underlying cryptography before dying in a politically-motivated duel at the age of 21. The result of the ensuing 10-year Galois partnership with the intelligence community is the Cryptol language and tools, which are in operational and commercial use today.

For Cryptol, Galois was able to complete the transition by itself from research through to operational deployment and support because its target user group was small and sophisticated. However, Galois leadership understood early on that larger operational deployments of emerging technology would need to be done by partners who had both the operational expertise, scope of capability and mission knowledge to make it happen. Galois believes that its mission imperative, unlike academia, is to locate, assess and work with such partners until the technology has been fully transitioned.

In the early to mid 2000s, building on its base of technical skills, Galois grew by extending its research initiatives to problem areas outside of cryptography. Galois was leveraging the excellence of its researchers and its independence from the academic mission to bring a new technology transition offering to research agencies in the government.

Galois participated in a research project under the Navy PMW 160 office to improve cross-domain information exchange. This project produced specific technologies that could be used in a significant number of different devices in both safety and security domains. However, challenges exist to deployment within these areas, chief of which is the amount of up-front investment required to bring a solution into use. Deployment of such devices is gated by various government certification processes such as TSABI and SABI, which can take from 12-24 months to complete. As a consequence, the existing solutions are aging and require substantial government investment to remain viable, even as they fall behind in meeting mission need.

Galois recognized that any deployment partner would need to see a large market potential prior to engaging in such an effort. As a result, Galois started nurturing partnerships in earnest at this point, readying the field for deployment opportunities.

Galois' history with SBIR

While working with the Navy, Galois became aware of the SBIR program, and had submitted and won an early Phase-I grant with the Air Force. During the period between the win and receiving the contract, the technical point of contact changed. Galois was naive about the structure of the SBIR program, and failed to respond to this shift in technical leadership with a change in the research initiative. As a consequence, we were not responsive to the new needs of the program office and were not awarded the Phase-II. This was an education to Galois about the differences between interacting with research agencies on long-term contracts and the pace and intent of the SBIR program.

However, Galois saw the potential for the SBIR program to motivate the investment necessary to bring capabilities to market by linking the technology to specific operational needs. Galois had also written several SBIR Phase-I proposals that augmented the Trusted Services Engine (TSE), a cross-domain information sharing device, which had been previously developed with Navy funding. One of these, *Cross-Domain Document-Based Collaboration in a Multi-Level Secure Environment*, resulted in Phase-II funding through the Navy, Phase-III funding through the intelligence community, transition of technology to a venture-backed startup and multiple operational deployment opportunities that are still in motion.

Because Galois is so aligned with the structure and intent of the SBIR program, we have increased our participation and written and won an increasing number of Phase-I grants and contracts, and have been moving some of those into Phase-II efforts. All of these involve taking research results from our longer-term initiatives, combining them with specific innovations that are responsive to operational needs, and producing new capabilities that are mature enough to see deployment in the short term.

Galois perspective on technology transition

Galois defines successful technology transition as the realization of significant new capability within existing problem domains through the application of revolutionary techniques that change the state of the practice. Technology transition is hard. It can take many, many years for a revolutionary technology to move from research into successful deployment.

Based on our experience, Galois believes the following:

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- **Expect the unexpected in technology transition**. It is extremely difficult to predict when and where the ultimate value of technology invention will be realized. Technologies may require long-term nurturing until the conditions are ripe.
- **Relevance and value comes from being strongly connected with the mission and needs of operational entities**. Innovation happens where technology evolution meets operational challenge.
- **Technology transition comes incrementally, and is built through a series of contributions by an entire eco-system of collaborators**. It is exactly the breadth and diversity of the customers and the funding mechanisms that enable a healthy system. The missions of academia, technology transition agents such as Galois, and operational solution providers are different, complementary and essential to ultimate success. The variety of government funding approaches are also essential and valuable: funding from fundamental research through university grants, through bespoke applied research including SBIR initiatives, together with maturation and readiness investment, all contribute to eventual success.

Impact of the SBIR Program

The SBIR program has had a significant impact on many dimensions of Galois' business. The following describes these, with evidence drawn from some of our SBIR contracts. We also draw general lessons from other relevant engagements that we are not at liberty to discuss in this forum.

Impact: SBIRs at Galois have enabled Oregon access to broader US government business

One major benefit of the SBIR program to Portland and to Oregon is the enhanced access to relationships with US government agencies, particularly those with operational needs. These relationships lead both to valuable results and further funding opportunities within and outside of the SBIR program.

It has been our experience that building a good government-focused research program requires ready access to people within relevant agencies. These relationships provide deep insights into the emerging problems as well as experience about how to navigate the government bid and

procurement process. Despite valuable potential, without these government relationships, businesses will stumble by failing to be truly responsive to needs or by missteps in bids and procurement. Most often, they are just 'late to the table' and miss opportunities.

Oregon is challenged geographically, both in distance and time zone, in identifying and cultivating close connections with agencies. Oregon does not have a rich community of former government workers from which to draw knowledge and experience.

The Congressional Record of the Senate, vol. 148, no. 120, from Sept 20, 2002, records Senator Wyden as alluding to the same challenge:

"Technology workers and managers from my home State of Oregon have inspired me with their technical skills and their passion to put their talents to work serving America. The Portland area is home to one of the Nation's largest concentration of cybersecurity vendors in the country. Portland now boasts a remarkable cluster of small and large companies actively working to make America's portion of cyber- space a safer place."

He then went on to mention Galois (called Galois Connections in 2002) directly:

"Galois Connections designs and develops high confidence software for critical and demanding applications. Its clientele includes the National Security Agency."

And then indirectly:

"It is essential to eliminate the road-blocks American innovators face. A 20-person company in Beaverton, OR shouldn't have to devote precious resources to hiring lobbyists, making multiple trips to see different people in different agencies, and pursuing expensive and, frankly, frequently obsolete certifications."

The SBIR program is very helpful in this regard. It offers a level playing field. Successful Phase-I work can be the springboard for relationships that lead to future work outside of the SBIR umbrella. Further, the contracting process is straightforward and cognizant of the limitations of small business. Galois has been able to increase its breadth and diversity through SBIR participation.

For example, in November of 2009 Galois was awarded a Phase-I SBIR to provide *Active*

Defense against Code Injection Attacks by Air Force Research Laboratory (AFRL), as part of their Software Protection Initiative (SPI). That single Phase-I award gave us the opportunity to build relationships with the broader cyber defense community, and a better understanding of the pressing problems they face in trying to secure cyberspace. This exposure has been instrumental in our success in building solutions that speak to the needs of both government and private industry. As a result, our initial Phase-I engagement has turned into multiple opportunities to develop, and eventually field, critical national security capabilities, such as run-time monitoring solutions that make UAVs more reliable and robust against software-based attacks. And we are particularly excited about the fact that these opportunities have a strong commercial component to them; we're actively involved with adoption partners to make the technology transition for these solutions a success, with benefits to both government agencies and private firms.

Impact: Galois SBIRs have provided technology and market opportunities for new ventures

In 2005, Galois won the aforementioned SBIR Phase-I award, *Cross-Domain Document-Based Collaboration in a Multi-Level Secure Environment*. The Navy had recognized the need for online collaboration, including with the multiplicity of coalition partners, and called for research on the topic. Inspired by the success of Wikipedia (which was only a few years old at the time), Galois saw the potential for wiki technology to act as a vehicle for collaborative data sharing. The insight was notable. Fully a year later, in April 2006, the Office of the Director of National Intelligence (ODNI) Intelligence Community Enterprise Services (ICES) announced Intellipedia, which is an online system for collaborative data sharing within the intelligence community (IC). Intellipedia consists of three wikis running on JWICS, SIPRNet, and Intelink-U, containing data at classification levels from Top Secret (TS) to Sensitive But Unclassified (SBU).

Galois' approach was to layer wiki technology on top of the Trusted Services Engine (TSE). Through successful Phase-I and Phase-II efforts, the cross-domain wiki technology was developed and demonstrated to multiple audiences within the DoD and IC, receiving Phase-III development funding from sources outside the SBIR program. Additionally, multiple conversations took place between Galois and Intellipedia staff, where each side shared ideas and insights.

In 2007, Galois connected with a Boston startup, KnowledgeBanking Systems (KSys). KSys were developing an enterprise information solution based on shared wikis, and were challenged by how to control when and when not to allow information to be shared. In a supply chain, companies need to have access to information about where their products or components will be used, and also need information from their suppliers, but they should not have access to information from their competing companies, not even to know who they are. KSys licensed the wiki technology from Galois, and worked with both government and industry to ensure that the solution they were building would be appropriate for their needs. KSys was about to close a major round of funding when the capital markets closed down with the banking crisis of 2008.

Impact: SBIR projects expose companies like Galois to real and current needs

One benefit of the frequent release of new SBIR topics from government agencies is that we as a private corporation are able to see what areas of work would serve critical, timely needs. The constant input that we receive through the SBIR program allows us to guide our research direction in order to not only answer the needs that we hear via SBIR solicitations in the present, but anticipate the needs that will arise in the near future.

Our current set of SBIR projects reflects this. For example, recent trends in mobile phone technology have pushed commercial products such as Android-based phones into security-critical environments. One of our DARPA-funded SBIR Phase-I projects (*FUSE: Inter-Application Security for Android*) leverages our existing research capabilities in program security analysis, and targets it specifically towards the Android mobile platform. Another example is the rise of scientific collaboration over large distances that heavily utilize Internet-based tools to share data and computing resources. We have successfully executed a Phase-I project and started a Phase-II project with the Department of Energy (*Grid 2.0: Collaboration and Sharing on the Grid*) to apply our expertise in building high assurance authentication and identity management software to this specific problem in computational science.

In both cases, the SBIR program has allowed us to take our broad research capabilities and apply them to specific application areas that answer timely, critical national needs.

Impact: SBIR support programs have built Galois commercialization capability

Galois has benefited from participation in several SBIR support resources, and especially from those that focus on transition and commercialization.

Prime among these is the Navy's Transition Assistance Program, or TAP, which gave Galois substantial new and useful understanding and capability in commercialization. The program is voluntary for Navy Phase-II winners, and requires a commitment in time and money from the company to participate. Over a year's time and under advisor guidance, Galois learned or improved capabilities in how to evaluate a particular market, assess a venture partner, write a business plan, produce marketing collateral that is informative to defense industry primes, and present at an industry-focused conference. Each of these skills has been reused and deepened since that experience. Of particular note, the Dawnbreaker advisor provided baseline criteria for examining venture opportunities, which Galois applied immediately to the KSys opportunity. This information facilitated the development of that commercialization effort.

Beyond the Navy TAP, there are several other national SBIR conferences held annually. These provide coaching on proposal writing, on the SBIR process itself, on building a good commercialization plan, among other things. These conferences also provide the opportunity to meet with prime contractors, and learn from fellow SBIR entrepreneurs.

Galois discovered a couple years ago, during web trawling, the excellent National Research Council in-depth studies of the SBIR program. The NRC findings and recommendations have transformed our understanding of the SBIR program, how the various agencies differ in their approaches to it, how to improve our chances of success of winning Phase-Is and IIs (particularly with regards to commercialization).

Another great example is the DHS' Commercialization Office, led by the nation's first Chief Commercialization Officer, Thomas Celluci. That office augments DHS' SBIR program by helping DHS SBIR TPOCs provide detailed operational requirements and a conservative market potential (across all DHS procurement), supporting the commercialization process, actively courting the private sector, and establishing public-private partnerships. Small businesses gain insights into how commercialization plans are assessed, which milestones and metrics will apply during execution, and into the needs of large government programs e.g., through CONOPS (Concept of Operations).

We have found, time and again, however, that there is no substitute for an engaged TPOC who is able to help the small business navigate the challenges of the SBIR program itself, and of the potential for application within the government.

Impact: SBIRs have enabled research developed for one agency to spread in impact to other agencies

One of the primary benefits of the SBIR program is its unique ability to promote research transition across government agencies. Through participants such as Galois, emerging research results generated under the sponsorship of one government agency have the potential to have immediate application across the government.

For example, the *Cross-Domain RSS Processor and Router* SBIR Phase-I from the Navy led to technology discussions and demonstrations with the intelligence community. Furthermore, the key ideas developed in the project became the core of the SBIR Phase-I *Grid 2.0: Collaboration and Sharing on the Grid* project with the Department of Energy and the Open Science Grid. Grid 2.0, now in Phase-II, is an effort to increase secure collaboration capabilities for scientists who require a lot of computational and storage resources. Its goal is to remove technical barriers to secure collaboration, including developing means of trusting digital identities among a global set of scientists from different institutions.

Impact: Galois SBIR work has brought global cybersecurity research capabilities to bear on national needs

The SBIR program fosters a dynamic ebb and flow of small companies, which have to respond rapidly to emerging needs, and even more, to emerging techniques. Phase-I SBIR proposals often have 30-50 competitors.

To compete, a company like Galois has to excel on the quality and relevance of its ideas. Unsurprisingly, therefore, within its technical domain, Galois has been motivated to draw together researchers with an international reputation.

The Association for Computing Machinery, the world's largest educational and scientific computing society, confers the designation "ACM Fellow" to a select number of ACM members whose accomplishments have distinguished themselves by outstanding technical and

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professional achievements in information technology. This year, Dr. John Launchbury, the founder and chief scientist of Galois, received this very high technical honor.

Beyond Dr. Launchbury, we have internationally recognized leaders in the fields of formal methods and their application to security issues (Dr. John Matthews, Dr. Joe Hurd, Dr. Joe Hendrix, Dr. Levent Erkök), in safety critical embedded systems (Dr. Lee Pike), in scientific computing and high performance computing (Dr. Matthew Sottile), and in all aspects of functional programming language design and implementation (Dr. Don Stewart, Isaac Potoczny-Jones, Dr. Iavor Diatchki, Dr. Andy Adams-Moran). Our researchers serve on editorial boards, program committees, academic steering committees, and give several invited talks per year.

This is just a small selection of the Galois researchers. The quality and international reputation of the staff make it possible for Galois researchers to bring the world's expertise to bear on research problems that influence SBIR work directly benefiting the US government and, more broadly, other entities within the US economy.

Additionally, the strength of our reputation within our technical domain allows us to attract notable speakers to our weekly public seminar series. These seminars draw participants from the many other companies in the Portland software community, as well as having a strong online following.

Recommendations

Galois has benefited substantially from its participation in the SBIR program, which we believe is valuable, structurally sound and strong. That said, we do have some thoughts about possible adjustments to meet emerging challenges. Most of these recommendations are targeted at incremental changes that we believe are in response to changing external conditions.

Recommendation: Augment success metrics for Phase-III to include open source

Galois recommends that Phase-III success metrics should be augmented to include evaluation for open source release of capabilities.

Galois strongly believes in the current SBIR approach to success metrics. We deeply appreciate that the SBIR success metrics are applied with failure as one expected outcome. This makes it

possible for Galois and others to try riskier approaches that may bring more significant value, rather than focusing on 'sure bets'. Galois also strongly endorses the Phase-III monetary metric as critical and sound for ensuring that SBIR investments overall are yielding value.

However, since the advent of the SBIR program in the 80s, there has been a new vector introduced that brings substantial value to the nation: open source software.

Open source software has made tangible changes in the way computer vendors do business over the last decade. In previous decades, major computer vendors commonly used proprietary system software on their products. While many of these proprietary systems still exist, many vendors have moved to offering open source, Linux-based solutions as either the preferred option or as an officially supported one. This is true of high performance computing platforms, for example, which are in use in many areas of the government for scientific and defense applications.

The move to open source is driven by the economic benefits that vendors gain from open platforms: contributions by the community at large can have tangible impacts on their specific products and user community with minimal investment as a consumer of these technologies. Open source has also had a strong impact on the security of software systems for users everywhere. The open source Firefox web browser is a clear example of this, where the transparency, open design, and rapid response to security flaws has made it a strong alternative to proprietary web browsers that have historically been less secure or less transparent about the quality of their security. Similarly, the Android mobile platform is a very visible example of an open source technology changing the business world. The smart phone market has been revolutionized by the presence of an open platform upon which vendors can build products that integrate with a broad third-party application developer community.

Open source challenges traditional paths towards commercialization of software, but the trends as accepted by both consumers and large computing businesses are clearly turned in a direction that favors open source development. For some of our SBIR customers, the most cost-effective and sensible method for providing a capability is not through transition to a commercial venture, but rather through an open source release that then *indirectly* enables business growth in providing additional functionality. This is particularly true of infrastructure improvements, that are best leveraged when widely available.

While Galois has been writing commercialization cases for Phase-I and Phase-II SBIRs that outline this strategy, we do so at odds with the SBIR metrics. This puts both our customers and ourselves at some evaluation risk, despite the fact that this is the most viable strategy. We'd like to see alignment of the metrics in support of the open source release, while ensuring that the metrics stay credible through an independent valuation of the open source release to ensure it is 'for real'.

Recommendation: Incrementally increase Phase-I award size to enable better assessment of results in consideration of Phase-II

Galois recommends increasing the Phase-I award size in tandem with inflation or other economic measures to ensure that it remains sufficient for proposers to accomplish tangible results sufficient to make assessments about Phase-II.

At the 2010 Phase-I levels, Galois was often faced with a difficult choice. Should we submit a proposal that had a riskier profile, knowing that we might not have sufficient runway to test some ideas? Or should we wait, losing this chance to bring results? Upon selection, we also faced hard choices about how to allocate the activities between testing and maturing the technology versus communicating those results to the client.

Since the relative value of the Phase-I award level has dropped significantly since the inception of the SBIR program, we'd like to see it restored to its original intended level. Increasing the Phase-I award in this way will enable better evaluation and decisions for investment of Phase-II dollars.

Recommendation: Accelerate Phase-I to Phase-II to meet the pace of software technology change

The pace of software technology change has increased tremendously since the SBIR program began. Consequently, Galois would like to see new approaches for accelerating the transition between the phases, including optionally shortening Phase-I performance periods and setting more aggressive evaluation timelines for Phase-II awards, at least within our problem domain areas.

In our experience, there is a gap from three to six months between Phase-I and Phase-II. During

this period, non-research technologies can become obsolete, requiring rework just to achieve baseline capabilities again. Needs have remained unmet during the gaps, exacerbating operational difficulties. Additionally, commercial market opportunities expire without the potential influence from SBIR results that may have yielded substantially better value.

Recommendation: Provide more support to Technical Points of Contact in the administration and guidance in SBIRs

The Technical Point of Contact (TPOC) plays a critical role in whether SBIR research is able to realize value to the government. They interpret and assess the government needs to the SBIR performers, guide the performers during the execution of the SBIR in administrative mechanics, set priorities and standards for delivery, and build the relationship with the small company.

Galois has had widely varying experience with TPOCs. Some have been extraordinary in their commitment to the SBIR results and to enabling Galois to produce relevant results. Others have been earnest but have lacked experience in one or more important dimensions of execution. Some TPOCs have a wealth of specific experience to share and can directly convey the needs of their agency. Others are more indirect, and take a more administrative stance in management. A rare few are openly unhappy about this accountability. And all of the TPOCs seem to be trying to fit in the SBIR work amongst multiple other priorities.

Prospects for success have been best for Galois when the investment of time and the level of commitment are high. In fact, these are often the same relationships that continue beyond the initial introduction through SBIR to enable Galois to extend and expand its contribution to larger agency needs.

Recommendation: Encourage TPOCs to provide connections with interested acquisition programs

In recent SBIR rounds, some SBIR agencies have listed Programs of Record along with some of the topic description, indicating where the need comes from or where a successful SBIR project might transition. This has been very helpful in identifying real customer need. We recommend linking Programs of Record more closely with the SBIR program, to greatly improve chances of a successful transition.

We recommend that TPOCs should be encouraged to introduce SBIR companies to Program Managers early in Phase-I, so that a SBIR project can be guided by the Acquisition Programs' needs. This will also foster a closer working relationship between TPOCs and Programs.

We recommend that Acquisition Programs should be incentivized to work with the SBIR companies working on topics that are relevant to the program. This may require a modification to how Programs of Record are assessed during execution. Programs are by nature very conservative as a response to their very strict success criteria, so have a strong incentive not to include the risky outcomes of SBIR projects within the Program, yet a successful innovation could dramatically increase the impact and effectiveness of the Program.

Recommendation: Provide incentives to prime contractors to incorporate useful SBIR advances into their offerings

Understanding advanced technology requires a prime contractor's better people to serve as 'technology acceptors'. Very typically those people are tied up on major procurements or ongoing projects, and may not be accessible or available to consider potentially valuable new technologies. Providing appropriate incentives for prime contractors to assess and utilize emerging SBIR results, particularly those deemed of interest by Programs, might accelerate the uptake of new technologies.

In conclusion

Let me underline a point I made earlier: each of these suggested improvements are offered with a view to making an excellent program stronger. In my view the SBIR program is immensely successful, both for fostering the innovation and jobs engine of small businesses, and for nurturing breakthrough technologies to the benefit of the government and wider economy.

Thank you again for the opportunity to appear before this Committee. I look forward to answering your questions.